


Appendix A

Mercury in Air Exposure Limits (mg/m³=milligrams per cubic meter of air)

A1	1.	ACGIH TLV (Threshold Limit Value) 1995-96	aryl compounds (8 hr average limit)	inorganic forms, including metallic mercury vapor (8 hr average limit)	alkyl compounds (8 hr average limit)	alkyl compounds (STEL= short term limit)
			0.1	0.025	0.01	0.03
		<i>Skin Notation</i> - significant exposure may take place through contact by mercury, its compounds or vapor with the skin, eyes, or mucuous membranes.				
			for example, applies to: phenylmercuric acetate	for example, applies to: metallic mercury mercuric oxide mercuric acetate mercuric chloride	for example, applies to: methyl mercury dimethyl mercury diethyl mercury methyl mercuric cyanide	
	2.	PEOSHA - same as ACGIH except metallic mercury vapor is 0.05 mg/m3				
	3.	OSHA PEL (Permissible Exposure Limit) 1974	all forms (ceiling limit) 0.1			
	4.	NIOSH REL (Recommended Exposure Limit) August 1973		inorganic (ceiling limit) 0.1	inorganic (8 hr average limit) 0.05	

APPENDIX B

RECOMMENDED MEDICAL MONITORING FOR WORKERS EXPOSED TO METALLIC AND INORGANIC MERCURY

Introduction

Medical monitoring is the periodic evaluation of exposed workers to ensure that they are experiencing no adverse effects of potentially hazardous workplace exposures. It serves as back-up for a program of routine air and biologic monitoring, which are the primary means for ensuring that exposure levels are below those associated with adverse health effects. A medical monitoring program should be designed to detect adverse effects of exposure as early as possible, at a stage where they are still reversible, so that exposures can be controlled and serious permanent adverse effects prevented.

Baseline and Periodic Examinations

An initial medical examination should be performed on all employees exposed to potentially hazardous levels of mercury. The purpose of this examination is to provide a baseline for future health monitoring.

The examination should include the following:

- * A complete medical history and symptom questionnaire, with emphasis on:
 - the nervous system (target organ for chronic exposure),
 - the kidneys (target organ for acute and chronic exposure),
 - the oral cavity (target organ for chronic exposure),
 - the lungs (target organ for acute exposure),
 - the eyes (affected by chronic exposure), and
 - the skin (since mercury is a known skin sensitizer).
- * Signs and symptoms of the earliest signs of mercury intoxication should be elicited; these include: personality changes, weight loss, irritability, fatigue, nervousness, loss of memory, indecision, and intellectual deterioration. Complaints of tremor and loss of coordination should also be sought.
- * Physical examination should focus on the target organs described above.
- * A baseline handwriting sample should be obtained.
- * Laboratory evaluation should include at minimum a complete urinalysis (see below).

This examination should be repeated annually. Results should be compared with the findings on the baseline examination for changes suggestive of mercury toxicity. Handwriting samples should be compared to the baseline sample for evidence of tremor. Interim evaluations should be conducted if symptoms suggestive of mercury intoxication are occurring.

Confidentiality of Medical Information

Questionnaire and physical examination results for periodic examination should be compared to the baseline examination to detect any change which might be attributed to mercury intoxication. The results should be conveyed in detail to the worker. The employer should be informed by the examining physician if mercury intoxication is suspected on the basis of symptoms or results of the physical examination or laboratory tests. If intoxication is suspected, the worker should be removed from exposure and expert medical consultation should be sought. ***The results of the physical exam should be kept confidential, and no management personnel other than health professionals should have access to the medical records.***

Importance of Evaluating Group Results

The results of the questionnaire and physical examination should also be evaluated on a group basis. This is important because early mercury poisoning might cause only very mild, clinically insignificant increases in symptomatology in each individual which, when seen in the aggregate, might provide an important clue that toxic exposure to mercury is taking place.

Who Should Perform the Medical Examinations?

All medical monitoring of exposed employees should be conducted by a physician knowledgeable in occupational medicine. In particular, interpretation of the group data should be undertaken only by a trained occupational health physician or other physician with expertise in performing such analyses.

Using More Sensitive Medical Tests

Several studies have shown that some special tests may be useful in detecting early signs of mercury toxicity.

Neurobehavioral tests, designed to detect early changes in concentration, response time, memory, and hand-eye coordination, can be useful on both an individual and a group basis in detecting early nervous system effects of mercury exposure.

Early kidney damage may be detected by looking for the presence of low molecular weight proteins in the urine. The presence of these proteins in the urine indicates that kidney damage has occurred long before a routine urinalysis indicates an abnormality. **Beta-2-microglobulin and N-acetyl-B-D-glucosaminidase (NAG)** are two of the proteins which can be measured in the urine. The tests are useful on both an individual and group basis.

These special tests should be arranged and interpreted by a trained occupational physician or other physician with special expertise in these areas.

Biologic Monitoring

Biologic monitoring is the measurement of a chemical agent in the blood, urine, or other body tissue of exposed individuals to determine how much of the chemical has been absorbed into the body. It serves as a back-up to environmental exposure measurements, since air measurements cannot assess skin exposure or the effects of protective equipment and work practices. *Since it measures the amount of an agent actually absorbed into the body, it is usually a better estimate of risk for adverse health effect than air monitoring.*

There is no ideal biologic monitor for evaluating the risks of mercury intoxication from metallic or inorganic mercury. Mercury can be measured in both blood and urine. Individual levels may vary greatly from day to day and even within a given day. While proper interpretation of the results can be difficult, the measurements can nevertheless provide information on potential overexposure. Measurements should be carried out regularly (several times per year) in chronically exposed workers, and individual as well as group results should be evaluated. Baseline levels should be obtained before exposure begins for comparison purposes.

Mercury in Urine

Measurement of mercury in urine is the recommended biologic monitor for workers exposed to metallic and inorganic mercury. Ideally, the collection should be over 24-hours. Spot urine samples may also be taken, but care must be taken to always collect them at the same time of day near the end of the work week after several months of steady exposure. Overnight samples may also be collected; this collection extends from the time the employee goes to bed through the first urination of the morning.

Samples must be collected in mercury-free containers which must be provided by the laboratory because a preservative must be added. At least 25 cc of urine must be collected. Great care must be taken to prevent contamination of the sample containers or the urine with mercury from the skin or workplace air.

When results are interpreted, the urine values should be corrected for grams of creatinine in the sample, and should be expressed as ug Hg/gram creatinine. In persons not occupationally exposed to mercury, urine levels rarely exceed 5 ug/g creatinine. ***Levels greater than or equal to 20 ug/g creatinine are reportable to the New Jersey Department of Health and Senior Services by laboratories and physicians.***

While many laboratories indicate that only levels above 150 ug/L should be considered toxic, there is strong evidence that early signs of mercury intoxication can be seen in workers excreting more than 50 ug Hg/L of urine (standardized for a urinary creatinine of 1 g/L). This value of 50 ug/g creatinine is proposed by many experts as a biological threshold limit value for chronic exposure to mercury vapor, and in 1980 this was endorsed by a World Health Organization study group.

Exposed individuals with levels above 50 ug/g creatinine should be placed in a non-exposed job until the reason for their overexposure has been identified and corrected and their urine levels have fallen below the biologic threshold limit value.

Mercury in Blood

The concentration of mercury in blood reflects exposure to organic mercury as well as metallic and inorganic mercury; thus, *it can be influenced by the consumption of fish containing methyl mercury*. Therefore, blood tests are **not** recommended for the routine evaluation of occupational mercury exposure.

Samples should always be taken at the same time of day near the end of the work week after several months of steady exposure. Whole blood should be collected in mercury-free heparinized tubes after careful skin cleansing. The recommended tubes are those sold for trace metal analysis; these generally have royal blue stoppers.

In unexposed individuals, the amount of mercury in blood is usually less than 2 ug/dL. ***Levels greater than or equal to 2.8 ug/dL are reportable to the New Jersey Department of Health and Senior Services by laboratories and physicians.*** According to some experts, an average airborne concentration of 50 ug/m³ corresponds to a mercury concentration in blood of about 3-3.5 mg/dL. Early effects of mercury toxicity have been found when the blood concentration exceeds 3 ug/dL. Any worker exceeding this level should be placed in a non-exposed job until dietary and workplace exposures have been evaluated and blood levels have returned to baseline.

Laboratory Analysis

Urine or blood samples should be submitted to a laboratory which is proficient in mercury analyses. Not all labs are proficient in these analyses. At present, the most reliable indication of such proficiency is successful participation in the interlaboratory comparison program for mercury urine and/or blood samples sponsored by the Quebec Toxicology Center. Questions on laboratory proficiency should be directed to the clinical lab's quality control department.

Removing Employees from Exposure

Individuals should be removed from mercury exposure if signs or symptoms of intoxication are detected on physical exam or if their biologic monitoring levels equal or exceed either:

- * 50 ug/g creatinine in urine
- * 3 ug/dL in blood

An individual who must be removed from mercury exposure because of elevated blood or urine mercury levels or physical examination results suggesting early mercury intoxication should be given alternative work with no exposure. His or her wages, benefits and seniority should be maintained. No employee should be terminated or otherwise punished because of overexposure to mercury.

Employees should be returned to work only after they are free of symptoms of mercury intoxication and mercury urine levels have fallen below 35 ug/g creatinine.

In the event that no job without mercury exposure is available, the employee may continue to work using a supplied air respirator, provided that biological monitoring results and/or symptoms display a satisfactory decline over time.

Written 1989; revised October 1995

Appendix C

SELECTING AND USING A HYGIENE CONSULTANT

At times, an industrial hygiene problem will defy your best efforts to find a solution: those are the times to seek the advice of an expert. Someone who has studied industrial hygiene problems for many years can often find a more economical solution than would occur to a newcomer or inexperienced individual.

This section covers what a consultant does; thus enabling you to make better use of the industrial hygiene consultant's services.

Many companies selling industrial hygiene instruments and products are staffed by engineers who are knowledgeable in industrial hygiene measurements and controls. They can advise you on industrial hygiene measurement techniques at no cost.

An industrial hygiene consultant, however, is an independent professional, group of professionals, a private consultant, or state government agency performing services for clients on a fee basis. Consulting services can be as broad or narrow as needed. Using a consultant usually guarantees that the project, whether long-term or occasional, will be solved with maximum skill and economy.

A consultant can offer the following:

- Creativity born of diverse experience with a wide range of problem-solving applications.
- Professional independence. An independent consultant is in a position to divorce judgment of methods and materials from all secondary interests and keep a purely objective viewpoint.
- The consultant strives to provide successful solutions at a reasonable cost.
- Organizational stability. The consultant lessens the need for the organization, administration and eventual disbandment of large internal staffs formed to meet peak load projects or specialized problems.
- Complete accreditation. Consultants are usually qualified by education and experience to give complete consulting services.
- Flexibility and mobility. The consultant is available whenever special counsel is required.

Used by permission of the National Safety Council, Itasca, Illinois

Selecting and Using a Hygiene Consultant

Before a decision is made about hiring a consultant, question whether the consultant can:

- Do the job faster?
- Do it better?
- Do it at less overall cost?

Typical situations when a consultant can be used are as follows:

- When you do not know exactly what to do
- When you do not know how to do it
- When you want outside advice
- When you need an unbiased viewpoint
- When you need access to special facilities. Special facilities or equipment may be needed for one project and cannot be justified as a purchase, or acquired in the time available.
- When you need to pursue alternate solutions. Staff may not be available internally to analyze many possible solutions to a problem.
- When you need to convince management to take a particular course of action. An in-company solution to a problem may exist, but management may refuse to believe the recommendations of its own people.

In the final analysis, the decision to hire an industrial hygiene consultant is determined by the economics of the situation.

Much of the material in this following section is adapted from the ***Occupational Exposure Sampling Strategy Manual***, NIOSH Publication No. 77-173, available through the U.S. Government Printing Office.

Industrial hygiene consultants are hired primarily to accomplish two major objectives: (1) to identify and evaluate potential health and safety hazards to workers in the occupational environment, and/or (2) to design effective controls to protect the workers. Competent industrial hygiene consultants should be able to perform both of these tasks because of their training and experience. Usually, consultants can evaluate the extent of employee exposures more efficiently because of their detailed knowledge of the proper sampling equipment and analytical procedures.

Industrial hygiene consultants can recommend whether or not control measures are required and the alternatives available. They can design, supervise the installation of, and evaluate the effectiveness of control measures.

Consultants can be used to keep management aware of both current and proposed federal and state regulations in the area of occupational health and safety. They can inform management when medical examinations of employees may be recommended or required by regulation. They should be able to recommend appropriate physicians or clinics specializing in occupational medicine. An industrial hygiene consultant can play a valuable role in providing the examining physician with information on the occupational exposures of employees.

Consultants can design employee training programs. A consultant can serve as an

Selecting and Using a Hygiene Consultant

expert witness if your company is involved in a lawsuit and data must be obtained, interpreted, and presented by a disinterested third party.

To maximize use of consulting services, the purpose of the investigation or study must be defined. In any problem-solving situation, it is important to find out what the problem really is--before you try to solve it. This is the essence of what a good consultant does. Company personnel may not always be able to describe the problem clearly.

The consultant is obligated to pinpoint the problem, regardless of what the client thinks it is. This can be difficult, to say the least, but it must be done. Nothing is so disconcerting as solving the wrong problem or a nonexistent problem.

Define the problem

First, try to formulate and define the problem; then list the specific qualifications and experience a consultant should have to solve this problem.

Currently any person can legally offer services as an industrial hygiene consultant; consequently, it is important to avoid hiring those who are unsuitable because of inexperience, incompetence, or lack of training. Individuals or firms billing themselves as industrial hygiene consultants can be broadly classified according to (1) whether they recommend a particular procedure, product, service, or control process, or (2) whether they are independent consultants.

Product-oriented individuals or firms vary in their backgrounds from nontechnical product sales personnel to experienced industrial hygiene professionals. Such "consulting" consists mainly of recommending appropriate equipment and facilities. This type of consultation may include assistance in soliciting proposals for the design and installation of control equipment, such as ventilation control systems or respirators.

The advantage of using this group directly is that you avoid consultant costs and pay only for the product or service. The disadvantage in dealing with a product-oriented consultant is that these consultants may not consider all options available. Thousands of dollars could be spent in purchasing a particular type of monitoring equipment or in implementing a particular control system, only to discover later that the desired results cannot be obtained or that another solution could have been obtained for less money.

If there are any doubts as to the proper method for solving a problem, then an independent consultant (one free from ties to a particular service or line of products) should be called in. It is this type of industrial hygiene consultant that will be discussed in the remainder of this section.

Sources

There are several sources one can go to for information and for names of consultants. One source of information is from professional associations and public-service organizations related to occupational safety and health. Three national groups are the American Industrial Hygiene Association (AIHA), American Society of Safety Engineers (ASSE), and the National Safety Council (NSC). These three have local chapters,

Selecting and Using a Hygiene Consultant

sections, or offices in major cities that can provide information and assistance. The AIHA publishes a nationwide list of industrial hygiene consultants in the January and July issues of the AIHA Journal.

Many insurance companies now have loss prevention programs that employ industrial hygienists. Inquiries should be made of your present insurer; you may want to compare the services they offer with those of other insurance companies. Finally, there may be a university or college in your area that has an environmental health program.

Selection

Selection of a consultant should be guided by one primary consideration--the qualification of the consulting staff for the project to be undertaken. The size of a consulting firm is seldom a reliable single determinant, nor is the length of time in practice a major factor for consideration.

A good line of action to follow is to consider the qualifications of a number of individuals or firms that appear to be capable of meeting the requirements of the project to be undertaken.

Select a limited number of individuals or firms that appear to be best qualified for the particular project. Write each of them individual letters. Describe briefly the project and inquire as to their interest in it. On receipt of affirmative answers, invite the companies to come in for separate personal interviews. At the interview, go over the qualifications and record of each firm. Have the firms submit up-to-date data and available staff information, a brief description of work on hand that might possibly conflict with your project, and the qualifications of specific key personnel who will be assigned to your company's project.

A series of questions for the consultant to answer is given here. They should not be given equal weight since some are minor in importance. (The list is organized roughly in descending order of importance.)

Selecting and Using a Hygiene Consultant

Experience

1. For how many years have you been professionally active in industrial hygiene?
2. Please supply a list of recent clients that you have served, preferably in this geographical area and on problems similar to those in which I am interested.
3. What teaching have you done or training have you had in industrial hygiene? What groups were involved- - university, industry, trade associations, civic groups, engineers, symposia?

Consultation Status

1. Are you now an independent consultant? For how many years? Full time or part time?
2. If part time:
 - a. Who is your chief employer or in what other business ventures are you involved?
 - b. Is your employer aware and does he approve of your part-time activity as an industrial hygiene consultant?

Education

1. What schools did you attend and what courses did you take related to industrial hygiene?
2. What degrees did you receive and when?
3. What special conferences, seminars, symposia, or short courses have you attended (especially recently) to stay current with industrial hygiene technical information and governmental regulations?
4. What other sources of information do you use to stay current with the field of industrial hygiene?

Professional Affiliations

1. What professional associations do you belong to? (Representative ones are the American Industrial Hygiene Association, American Conference of Governmental Industrial Hygienists, and the American Society of Safety Engineers.) What is your present grade of membership and length of time in that grade for each association?
2. Are you certified by either the:
 - a. American Board of Industrial Hygiene (specify area of certification)
 - b. Board of Certified Safety Professionals
3. Are you a registered professional engineer? In what states and disciplines?
4. Of what professional engineer associations are you or your firm a member?
5. Of what trade associations, chambers of commerce, or similar business groups are you or your firm a member?

Special Capabilities

1. In what areas of industrial hygiene do you specialize?
2. What equipment do you have for conducting industrial hygiene evaluations?
3. What laboratories do you use for the analysis of your exposure measurement samples?
4. Can you serve as an expert witness, either for your client or as a friend of the court?
5. What experience have you had as an expert witness?

Business Practices

1. Please indicate your fee structure. Do you work by hourly charges, estimates for the total job, retainer charges, or a combination of these?
2. In your charges, how do you treat such expenses as travel, subsistence, shipping, report reproduction, and computer time?
3. Can you supply a list of typical laboratory analytical fees?

Compensation

Compensation for consultant services may be calculated and established by a variety of methods.

- Fixed lump sum
- Cost plus a fixed amount
- Salary cost times a factor, plus incurred or out-of-pocket expenses
- Per diem

As with medical, legal, and other professional services, consulting services should never be secured purely on the basis of a price comparison. Competitive proposals for professional consulting services are undesirable because there is no direct cost basis for comparison of services that involve judgment and creative thinking. These factors cannot be evaluated precisely in advance of performance.

The Proposal

Once you have selected a consultant, you can arrange to obtain services in several ways. A verbal commitment is sometimes all that is necessary. However, you may wish to request a written proposal that spells out the steps to be taken in the solution of your problem.

Aside from background qualifications of the consultant, the proposal should answer the questions:

1. How much is the service going to cost? Smaller jobs are often bid on an hourly basis, with a minimum of one-half day's work, plus direct expenses commonly specified. Larger jobs are usually bid at a fixed amount.
2. What is the consultant going to do? The answer to this question may range all the way from a simple agreement to study the problem to a comprehensive step-by-step plan to solve it.
3. What will be the end result? The answer to this question all too often not clearly understood; the result is usually a report that specifies the consultant's recommendation. If you do not want to pay for the preparation of a written report because a verbal one will do, specify this in advance.

Since recommendations often call for construction or other operations to be carried out by others whose work is not subject to the consultant's control, results can usually not be guaranteed by the consultant. Rather, an estimate of the exposure control to be attained is all that can be expected.

If the consultant is to provide drawings from which the contractor will work, the proposal must specify sketches or finished drawings. If special materials are required, the consultant should agree to specify alternative selections, if possible. If you want a guaranteed result, experimental work will usually be necessary and will have to be paid for.

The consultant can also monitor construction to determine compliance with specifications. The consultant can also measure after installation to confirm predictions and supply oral briefings as needed.

Even if your consultant is to serve as an expert witness for you, the consultant is not automatically on your side. Rather, the consultant is more like a friend of the court, devoted to bringing out the facts, with careful separation of fact from expert opinion.

Working with the Consultant

Once an industrial hygiene consultant is hired, the problem should be defined as exactly as possible. There should be no guesswork unless there is no other choice. All the data bearing on the problem should be provided at the beginning of the study or investigation. It does no good to leave out embarrassing or unpleasant facts. (The consultant will find them anyway, and the extra time spent will cost you money.) The consultant should be introduced to key members in your organization, and appropriate personnel should be available when needed.

Before hiring a consultant, consider the following items. Be sure to have any necessary equipment available and a place for the consultant to work. Do not let the consultant wander around alone trying to find information or things. Do not hold back information from the consultant.

Monitor the consultant's progress regularly. Check to see that corporate personnel are cooperating fully, that there is no personality conflict, and that the consultant is getting the help desired.

Review particularly the beginning phases including the formulation of the problem and the analysis of the problem. Review at the end of each phase.

The Three Phases of Consulting Work

Most consulting work can be divided into three phases--problem definition, problem analysis, and the solution phase.

The problem definition phase lays the groundwork for subsequent stages. The need for thoroughness and accuracy at this stage is obvious.

The problem analysis phase deals with the facts. The consultant defines the problem and identifies the opportunities for improvement, determines the causes of the problem, determines the objectives to be met by the solution, and develops alternative solutions.

The solution phase involves selecting the most effective, workable, timely and practical solution. The details of the solution must be worked out carefully. The solution should be the equivalent of a blueprint describing what needs to be done, how it is to be done, by whom, and in what sequence the actions are to take place.

Problems and Pitfalls

The successful consulting job is always a team effort between company and the consultant. Too often a consultant is literally challenged to do a successful job as though someone were saying, "We couldn't do it and neither can you."

Some typical problems and pitfalls that you may run into are described here. Some of these items are negative versions of items on the checklist. Some of the failures listed are the company's fault, some are the consultant's, and some involve both.

These pitfalls include the following:

- Failure to clearly define the problem.
- Failure to set specific objectives.
- Failure to establish financial arrangements in the beginning.
- Failure to establish realistic time requirements.
- Failure to select the best qualified consultant.
- Failure to make all pertinent information available to the consultant.
- Failure to obtain a clear and complete proposal from the consultant.
- Failure to review the oral or written proposal for clarity completeness, creative approaches and qualification.
- Failure to make a cost/benefit analysis.
- Failure to review progress periodically.
- Failure because of exceeding the scope of the assignment.

Achieving the greatest value from a consultant is largely a matter of providing full information, defining responsibilities clearly, and establishing workable lines of communication. The consultant should have full information regarding the project from the outset. The where, when, how, and why of the task are the very tools needed to solve the problem.

Appendix D
Worksheet for Gathering Information About
Work Involving Metallic Mercury

Location/building/floor/department:

Operation/process/machines/work stations:

Overview of how mercury is used in this location and operation:

Hours of shifts on which mercury is used:

Frequency of mercury use in days per week, month, or year:

Amount of mercury (give units of weight or volume) used per week, month, or year:

Employees working with mercury:

Job Title	Number of employees in title per shift		
	1st	2nd	3rd
1.			
2.			
3.			
etc.			

Tasks involving potential exposure:

Job title	Task Description	Frequency days/week	Duration hours/day
1.	1.		
	2.		
	3.		
2.	1.		
	etc.		

Job title number and Task description number	Rate potential for each route of exposure:		
	Inhalation	Skin absorption	Injection
example - 1.1.			
example - 1.2.			

Appendix E
Worksheet for Gathering Information About
Controls for Metallic Mercury

Job title number and Task description number	List Controls to Prevent Each Route of Exposure		
	Inhalation	Skin absorption	Injection
example -1.1.			
example -1.2.			

Checklist of Recommended Written Procedures

- ☐ Written Hazard Communication Program, required by OSHA 1910.1200
- ☐ Written Respirator Program, required by OSHA 1910.134
- ☐ Written certification that a workplace hazard assessment has been performed to determine if hazards are present that require the use of personal protective equipment, required by OSHA 1910.132
- ☐ Written mercury spill clean-up procedures
- ☐ Written mercury exposure and control assessment
- ☐ Written mercury handling and control procedures
- ☐ Written mercury medical surveillance and medical removal procedures

Appendix F

Guidelines for the Safe Clean-up of Mercury Spilled in the Workplace

Importance of Safe Clean-up

Mercury is a very toxic silver-gray liquid metal. When mercury metal is spilled, it forms droplets that can accumulate in the tiniest of spaces and in small pools and droplets and then emit vapor into the air. Spilled mercury which is not cleaned up properly creates potential mercury exposure for employees and visitors in the area of the spill. Liquid mercury gives off vapor which is odorless and colorless; the warmer it is the more vapor is emitted. Even a small amount of spilled mercury is enough to create a health hazard, especially if it is vaporized by heat or vacuuming with an ordinary vacuum cleaner.

Spill Prevention is Preferable to Spill Clean-up

It is much better to prevent a mercury spill than to be forced to clean it up.

It is important to have established, written work procedures for processes involving the handling of mercury or equipment containing mercury. Workers should receive thorough training in safe handling practices. All handling of mercury should be done over an appropriate container capable of catching any drips or spills. Where possible, substitutes should be found for mercury, e.g. alcohol-filled or electronic digital thermometers rather than ones filled with mercury. Where it is known that mercury spills are likely, floors should be sealed so they are free of cracks and crevices.

For more information on this topic see the NJDOH publication:

- **Controlling Metallic Mercury Exposure in the Workplace**
-

Planning is Needed

The following issues should be addressed in advance in every workplace which uses mercury, preferably by establishing written mercury spill clean-up procedures.

1. ***Lines of authority.*** To whom in management spills should be reported. Who is responsible for taking charge of the spill area.
2. ***Site control measures.*** Spill containment and area protection procedures. Limiting the spread of mercury until clean-up begins. Decontamination of employees if

Safe Clean-up of Mercury Spilled in the Workplace

contaminated during the spill.

3. **Criteria for assessing** the size and difficulty of cleaning up the spill and deciding whether the spill will be cleaned up by:
 - a. employees in the immediate area of the spill
 - b. employees on the Hazardous Materials team
 - c. an outside contractor
4. **Step-by-step procedures** for conducting the clean-up under various probable scenarios of size and difficulty.
5. **Equipment available** for use in spill clean-up.
6. **Training** of personnel to be involved in the clean-up.
7. **Personal protective equipment** to be used during the clean-up.
8. **Reoccupancy criteria** for deciding that enough clean-up has been done and the area can be re-occupied.
9. **Disposal** procedures for the mercury and mercury-contaminated waste.
10. **Legal requirements** including compliance with OSHA and PEOSH regulations; compliance with regulations on mercury disposal.
11. **Medical surveillance** to be certain that employees are not getting sick from mercury exposure.

What NEVER to Do About a Mercury Spill

Never use an ordinary shop vacuum cleaner to clean up mercury. The vacuum will put mercury vapor into the air and increase exposure. The vacuum cleaner will be contaminated and have to be thrown away. Special mercury vacuums, however, are commercially available and can safely be used. ***See Appendix 2 for a listing of commercially available mercury vacuums.***

Never use a broom to clean up mercury. It will break the mercury into smaller beads and spread them around.

Never use an ordinary vacuum pump to clean up mercury. The pump exhaust will put mercury vapor into the air and increase exposure unless it is very well filtered.

Never pour or allow mercury go down a drain. Not only is this a violation of environmental regulations, but the mercury may lodge in the plumbing and cause future problems during plumbing repairs. Dumping mercury onto the ground or into waterways is also illegal. Information on recycling mercury is given later in this document.

Never allow people whose shoes or clothing may be contaminated with mercury to walk around. They may spread the mercury contamination.

Very Important Note: Some discussion of the previous eleven issues is given below along with some NJDHSS recommendations. ***It is the employer's responsibility to properly utilize this information and write a complete spill clean-up protocol appropriate for the specific workplace.***

Spill Containment and Area Protection

Use diking to prevent the mercury from rolling on sloped surfaces. Divert mercury away from floor drains and cracks and crevices. Keep away all persons not involved in clean-up. Close doors to other areas. Post warning signs and barriers to prevent entry by unauthorized persons; post a sentry if necessary. Open windows and doors to the outdoors. Turn on fans only if they exhaust directly to the outside. Turn off any heating, ventilating or air conditioning system that circulates air from the spill area to other parts of the workplace. Turn off or lower any type of heat as far as possible since mercury vaporization increases significantly with temperature. Turn on window air conditioners, if available, to cool the area and reduce vaporization.

Decontaminate Employees

Employees involved in the spill should be visually examined for evidence of mercury on their skin, hair, shoes, and/or clothing during the spill, they should stay in the area so that they do not spread the mercury elsewhere. Have them put their contaminated shoes/clothing into a trash bag, wipe any visible mercury off their skin into the bag, and then have them shower and shampoo well.

Assess the Size and Difficulty of Cleaning Up the Spill

Estimate the amount of mercury that was spilled and the size of the area affected. Note what types of surfaces mercury was spilled onto in terms of whether they are hard or porous, accessible or difficult to reach, contain cracks or crevices or are free of these, are disposable or permanent.

A spill on a hard surface, free of cracks and crevices, in a limited and easy to reach area, can probably be handled by properly trained and equipped employees in the immediate area of the spill.

A spill on a hard surface with some cracks and crevices, in a limited area with some difficult to reach places, or on disposable porous item such as clothing, can probably be handled by a properly trained and equipped Hazardous Materials team. Any outside HazMat team and their emergency phone numbers must be specified in your emergency response plan.

Safe Clean-up of Mercury Spilled in the Workplace

For very large, more difficult spills, or spills on permanent porous items such as wall-to-wall carpeting, we recommend employing a contractor skilled in mercury clean-up. ***See Appendix 1 for a listing of mercury clean-up firms in the New Jersey area.*** When choosing a contractor, be sure to check references.

Equipment Available for Use in a Mercury Spill Clean-up

Many of the items useful in cleaning up a mercury spill are readily available and can be assembled in advance into a spill kit to be available if needed. Everything used in a clean-up will need to be thrown away after use unless you are positive it has not come into contact with mercury.

- * rubber squeegee
- * dust pan
- * plastic trash bags
- * plastic bags which zipper shut
- * flashlight
- * wide mouth container
- * large tray or box
- * paper towels or napkins
- * powdered sulfur (visualizes mercury by turning from yellow to brown)
- * powdered zinc (amalgamates mercury)
- * syringe with blunt needle (optional)
- * eye dropper (optional)

In addition, a mercury vapor meter will be needed both to assess airborne exposure and to decide whether the area has been cleaned-up well enough to allow re-occupancy. For both of these purposes, a mercury vapor meter is better than other ways of measuring mercury in air for two reasons. First, a meter gives an immediate reading so that decisions concerning the level of respiratory protection required and whether more clean-up is necessary can be made at once. Second, a meter is the only direct reading method which is sensitive enough to read down to the recommended clearance level. Meters must be calibrated regularly at the factory and used according to the manufacturer's directions. ***See Appendix 3 for a listing of commercially available mercury vapor meters.***

Mercury spill clean-up kits are commercially available and convenient but not absolutely necessary. In addition to devices designed to pick up the mercury, they usually contain equipment to roughly measure mercury in the air, and chemicals to visualize mercury, to amalgamate mercury, and/or to convert mercury to a form which will not vaporize (solutions of 20 percent calcium sulfide or 20 percent sodium thiosulfate). ***See Appendix 4 for a listing of commercially available mercury clean-up/control products.***

Safe Clean-up of Mercury Spilled in the Workplace

Mercury vacuums are commercially available and useful. However, they are expensive and not absolutely necessary for spill clean-up. If, however, one is already available in the workplace, it will probably be useful in a clean-up. ***See Appendix 2 for a listing of commercially available mercury vacuums.***

Clean-up Methods

Mercury is a very dense, non-wetting liquid that has a great affinity for itself. Beads of mercury can be pushed together with a squeegee and will form larger droplets. These can be collected in a dust pan and poured into a plastic bag or container. Work from the outside of the spill area towards the center. It is safest to work over a large tray or box when pouring mercury. Mercury's high density and smoothness cause it to roll fast. A flashlight can be used to look all around in the area of the spill. The flashlight will reflect off the shiny silver mercury beads and make it easier to see them.

Alternatively, a disposable syringe with a blunt needle or eye dropper can be used to draw up the mercury. If glass is mixed with mercury, large pieces of glass should be picked up first. Working on the tray, place the pieces on a paper towel, fold, place in plastic bag, and seal.

Sprinkle powdered sulfur in the spill area. If it turns from yellow to brown, this indicates that mercury is still present and more clean-up is needed. Sprinkle powdered zinc to suppress vaporization of any small amounts of mercury which remain.

Training of Personnel to be Involved in the Clean-Up

Employees should be trained and competent at the level at which they will be expected to function in case of a mercury spill. All employees should be trained to report spills to the proper person. Under the OSHA and PEOSH Hazard Communication and Personal Protective Equipment (PPE) standards, all employees must be trained in the following topics:

- Operations in their work area where mercury is present
- Methods to detect the presence or release of mercury
- Health hazards of mercury
- Protective work practices and emergency procedures
- When PPE is necessary
- What PPE is necessary
- How to properly put on, remove, adjust, and wear PPE
- Proper care, maintenance, useful life, and disposal methods for PPE
- Limitations of PPE

Under 1910.120 (q), OSHA and PEOSH require the employer to identify in advance and provide an appropriate level of training for employees involved in clean-up of an uncontrolled mercury spill outside of their immediate work area. Annual re-training or demonstrated competence of employees is required.

Personal Protective Equipment to be Used During the Clean-up

OSHA/PEOSH standard 1910.132 requires employers to determine the appropriate personal protective equipment for each hazard and to train employees on how and when to use protective equipment.

Air monitoring should be done using a mercury vapor meter to permit correct respirator selection. Be aware that air levels of mercury vapor will probably increase 10-20 times during the clean-up due to the mercury being disturbed. The NJDHSS recommends that the ACGIH Threshold Limit Value (TLV) of 0.025 mg/m³ be utilized in selecting the appropriate respirator for protection against mercury vapor because it is the most protective published exposure limit. If airborne exposure to mercury vapor does not exceed 0.25 mg/m³ (10 times the TLV), a half-mask cartridge respirator approved for protection against mercury vapor can be selected. If airborne exposure does not exceed 1.25 mg/m³ (50 times the TLV), a full-face cartridge respirator can be selected. If airborne exposures exceed 1.25 mg/m³, a self-contained breathing apparatus should be used. ***Appendix 5 contains information on***

cartridge respirators approved for protection against mercury vapor.

Other personal protective equipment which may be necessary include chemical resistant clothing, gloves, boots or shoe covers, and eye and face protection. There is almost no qualitative information available at the present time on what type of gloves and clothing materials offer protection from breakthrough, permeation, or degradation by mercury. Gloves manufacturers have recommended viton neoprene, neoprene, PVC, and butyl neoprene for protection against mercury. However, vendor recommendations may be based on factors other than impermeability such as resistance to being cut by glass. DuPont has found their proprietary chemical protective clothing materials, 2-Ply Tyvek®/Saranex® and Barricade®, to have mercury breakthrough times greater than 480 minutes and no detected permeation. In general, gloves and protective clothing should not be assumed to provide full protection from skin absorption.

Criteria for Reoccupancy

Before it is reoccupied for normal use, the area of the spill should be cleaned enough so that the level of mercury vapor present in the air is well below the 8 hour exposure limit of 0.025 mg/m³ (25 ug/m³) recommended by ACGIH. Clean-up to the level of 0.3 ug/m³ in air is recommended by the New Jersey Department of Environmental Protection (NJDEP). To determine if this standard is being met, mercury in air readings should be taken throughout the area of the spill at the breathing zone level (five feet from the floor) using a mercury vapor meter.

Wipe samples of cleaned surfaces should also be taken to determine if any mercury is left on the surface. ***See Appendix 3, page 8 for the wipe sampling method for mercury.***

Disposal

Under New Jersey Department of Environmental Protection (NJDEP) regulations, if mercury that is a commercial chemical product is spilled, it is a hazardous waste with the code U151. When the spilled mercury is cleaned up, the clean-up material is a hazardous waste according to the “mixture rule” at N.J.A.C. 7:26-8.1(a)2iii and would also have the waste code U151. This determination is not concentration dependent.

However, if the spilled mercury was not a commercial chemical product or was from an unknown source, the generator would have to determine if the mixture contained mercury at or above 0.2 milligrams per liter (0.2 mg/L) according to the Toxicity Characteristic Leaching Procedure (TLCP) at N.J.A.C. 7:26-8.12. If the threshold is exceeded, the waste must be disposed of as containing mercury.

In both cases described above, waste must be manifested, and shipped to a facility licensed to accept mercury-containing waste. Such facilities require the waste generator to obtain prior approval based on a review of the waste profile before the waste can be sent to them. Disposal prices are based on the amount and type of waste and can be obtained only after the waste is tested and profiled. ***A listing of facilities which accept mercury-containing waste is given in Appendix 6.***

Legal Requirements

The following OSHA Regulations are applicable to most situations involving the clean-up of mercury spills; for most a plain English explanation is available from OSHA. Call their publications office at 202-219-4667.

1910.134- Respiratory Protection-See OSHA Publication 3079, Respiratory Protection

1910.132- Chemical Protective Gloves and Clothing- See OSHA Publication 3077, Personal Protective Equipment

1910.1200- Hazard Communication- See OSHA Publication 3084, Chemical Hazard Communication

1910.120- Spill clean-up/emergency response- See OSHA Publication 3088, How To Prepare for Workplace Emergencies

1910.20- Access to Medical and Monitoring Data- See OSHA Publication 3110, Access to Medical and Exposure Records

1910.1000, Table Z-2- Acceptable Ceiling Concentration for Mercury

Medical Surveillance

To evaluate exposure to mercury, the following are recommended:

◆ Measurement of mercury in urine. Ideally, the collection should be over 24 hours. Spot urine samples may also be taken; these must be taken at the same time of day near the end of the work week and corrected for creatinine. This test is not affected by eating fish containing methyl mercury. Results greater than 20 micrograms per liter (20ug/L) indicate exposure.

◆ Complete medical history and symptom questionnaire, with emphasis on the nervous system, the kidneys, the oral cavity, the lungs, the eyes, and the skin. Physical exam should focus on these target organs. A baseline handwriting sample should be obtained and compared with later samples.

If you maintain a HazMat team, note that 1910.120(q), OSHA and PEOSH requires that members of Hazardous Materials Teams and Hazardous Material Specialists receive baseline physical examinations and yearly exams to evaluate the potential for impairment due to chemicals exposures. These examinations must be provided at no cost to employees and at a reasonable time and place.

For more information on this topic see the NJDHSS publication:

- **Recommended Medical Monitoring for Workers Exposed to Metallic and Inorganic Mercury**
-

APPENDIX 1

MERCURY CLEAN-UP CONTRACTORS IN THE NEW JERSEY AREA*

**Absolute Environmental Services
3705 Trindle Road
Camp Hill, PA 17011
717-730-8400**

**Acton Associates
P.O. Box 726
101 Thompson Street
Pittstown, PA 18640
717-654-0612**

**Advanced Environmental Technical
Services
3100 Hedley Street
Philadelphia, PA 19137
215-289-3700
and
One Eden Lane
Flanders, NJ 07836
201-347-7111
1-800-426-2382**

**Clean Harbors
2301 Pennsylvania Avenue
Deptford, NJ 08096
1-800-544-3128
609-589-5000
and
3 Sutton Place
Edison, NJ 08817
1-800-782-8805
908-248-1997**

**Guardian Environmental Services
1280 Porter Road
Bear, DE 19701-1347
302-834-1000
1-800-345-4395**

**Inland Pollution Services
935--939 Fairmont Avenue
Elizabeth, NJ 07201
908-353-5544**

**Recon Environmental
5 Johnson Drive
P.O. Box 130
Raritan, NJ 08869
908-526-1000**

**Solucorp Industries
520 Victor Street
Saddle Brook, NJ 07663
201-368-7902**

**United States Environmental
Services
16 W. Indiana Lane
Morristown, PA 19403
610-539-3233**

**Clean Venture
Route 322, R.D. 1, Box 202-B
Swedesboro, NJ 08085
609-467-4488
and
201 South First Street
Elizabeth, NJ 07206
908-355-5800**

*** Disclaimer: No assessment of quality of services has been made. The New Jersey Department of Health neither recommends nor endorses these or any other providers of mercury clean-up services.**

APPENDIX 2

MERCURY VACUUMS

HgVacupick

**Bethlehem Apparatus Co., Inc.
890 Front Street
P.O. Box Y
Hellertown, PA 18055
610-838-7034**

MRS 1, MRS 2, MRS 3, MRS 4, MRS 6

**Minuteman International, Inc.
111 South Rohlwing Road
Addison, Illinois 60101
708-627-6900
1-800-323-9420**

Mini-Merc

Mercury Vacuum

**Nilfisk of America
300 Technology Drive
Malvern, PA 19355
610-647-6420
1-800-645-3475**

Mercury Hand Vacuum

**Lab Safety Supply, Inc.
401 S. Wright Rd.
Janesville, WI 53546
608-754-2345
1-800-356-0783**

APPENDIX 3

MERCURY INDUSTRIAL HYGIENE MONITORING METHODS

DIRECT READING METHODS

UNIT NAME	MODEL CATALOG	AVAILABLE FROM	PRINCIPAL OF OPERATION	RANGE mg/m ³	ADVANTAGES	DISADVANTAGES
Mercury Vapor Sniffer For Mercury Vapor Only	MV-2	Bacharach Inc. 625 Alpha Drive Pittsburgh, PA 15238 412-963-2000 Fax 412-963-2091 Telex 24-7656	Ultraviolet Photometer	0 - 0.2 and 0 - 1.0 mg/m ³ Sensitivity > 0.01 mg/m ³ Speed of Response: less than 30 Sec. To 90%	Portable/6 lbs. 4 hr. battery life. Readings can be accurately set to zero even in a contaminated atmosphere. Results available immediately.	The vapors of some organic compounds such as benzene ring compounds, halogenated hydrocarbons and particulates absorb ultraviolet light at the lamp frequency.
Gold Coil Dosimeter For Mercury Vapor Only	X-412	Arizona Inst. Corp. 1100 E. University Drive P.O. Box 1930 Tempe, AZ 85280 602-731-3400 1-800-528-7411 Fax 602-731-3434	Collects mercury vapor on gold film and desorbs when connected with Jerome Monitor. (See next entry).	Variable Range; Sensitivity: < 0.5 x 10 ⁻⁹ g Capacity: > 1000 x 10 ⁻⁹ g Accuracy: ± 15% @ 0.107 mg/m ³	Provides 8-hour TWA for personal exposure. In-house analysis provides fast results. Economical, reusable. Weight: 1-5 ounces.	Not accepted by OSHA for 8-hour TWA. Analysis requires connection with Jerome mercury meter.

Appendix 3 - MERCURY INDUSTRIAL HYGIENE MONITORING METHODS (Continued)**DIRECT READING METHODS**

UNIT NAME	MODEL CATALOG	AVAILABLE FROM	PRINCIPAL OF OPERATION	RANGE mg/m³	ADVANTAGES	DISADVANTAGES
Jerome Mercury Vapor Analyzer For Mercury Vapor Only	431-X	Arizona Inst. Corp. Jerome Division 1100 E. University Drive P.O. Box 1930 Tempe, AZ 85280 602-731-3400 1-800-528-7411 Fax 602-731-3434	Change in resistance of gold film as function of mercury vapor	0.000 to 0.999 mg/m ³ Hg Sensitivity 0.003 mg/m ³	Portable/7 lbs. 6 hour battery life. Accuracy \pm 5% at 0.100 mg/m ³ Hg. Complete monitoring package includes base station, data logger and reusable personal gold coil dosimeters (gold coil dosimeters, used in conjunction with a flow pump and the Jerome 431-X, can provide in-house time weighted average for personal mercury exposure. (See previous entry). Selective to mercury, no interferences from particulates, hydrocarbons and magnetic fields.	In a heavily contaminated atmosphere, if the instrument pegs, it must be taken out of the contaminated area and allowed to re-zero which takes a few minutes.

Appendix 3 - MERCURY INDUSTRIAL HYGIENE MONITORING METHODS (Continued)

DIRECT READING METHODS

UNIT NAME	MODEL CATALOG	AVAILABLE FROM	PRINCIPAL OF OPERATION	RANGE mg/m ³	ADVANTAGES	DISADVANTAGES
MSA Mercury Detector Tube and Kwik-Draw Pump For Mercury Vapor Only	497663	Mine Safety Appliances Co. P.O. Box 426 Pittsburgh, PA 15230 1-800-MSA-2222 412-967-3000 Telex 812453	Reaction of mercury with copper iodide	0.1 - 0.8 mg/m ³	Easy to use. Operating range 30 to 120 °F and relative humidity 10 to 90%. Inexpensive. Results available immediately.	Limited accuracy ± 25%. 20 - 30 seconds per pump stroke. 20 pump strokes required.
Draeger Mercury Vapor Detector Tube and Pump For Mercury Vapor Only	CH 23101	National Draeger Inc. 101 Technology Drive Pittsburgh, PA 15275 1-800-922-5518 Fax 1-800-922-5519 Telex 86-6704	Reaction of mercury with cuprous iodide	0.05 - 2 mg/m ³ (1 to 40 pump strokes, max. time 10 minutes)	Easy to use. Inexpensive. Results available immediately. Arsenic, phosphine, hydrogen sulfide, ammonia, nitrogen dioxide, sulfur dioxide, and hydrazine in the TLV range do not interfere.	Limited accuracy ± 30%, Chlorine and other free halogens give low readings. Up to 40 pump squeezes required.
Sensidyne Mercury Vapor Detector Tube and Pump For Mercury Vapor Only	40	Sensidyne 16333 Bay Vista Drive Clearwater, FL 34620 1-800-451-9444 Fax (813) 539-0550	Mercury vapor reacts with copper iodide to form Cu-Hg complex	0.25 - 6.0 mg/m ³ (1 pump stroke) 0.05 - 0.25 mg/m ³ (5 pump strokes) 6.0 - 13.2 (½ pump stroke)	Easy to use. Inexpensive. Results available immediately.	Limited accuracy ± 25%, accuracy further limited in presence of hydrogen sulfide, nitrogen dioxide and chlorine.
Chromair Passive Badge For Mercury Vapor Only	380018-10	K & M Gillian Environmental 2421 Boulevard Parkway Unit 102 Virginia Beach, VA 23454 804-431-2260	Proprietary	0.15 - 1.4 mg/m ³ x hours minimum (8 hours) Detectable conc. 0.15 mg/m ³ Rel. Humidity Range 25 - 85%	Easy to use. Cost effective screening tool. Inexpensive. Results available immediately.	Limited accuracy ± 20%. Interferences from chlorine and bromine. Require refrigeration at 4°C.
Safeair Passive Badge For Mercury Vapor Only	382005	K & M Gillian Environmental 2421 Boulevard Parkway Unit 102 Virginia Beach, VA 23454 804-431-2260	Proprietary	0.1 - 0.2 mg/m ³ x hours. Min. Detection limit 0.013 - 0.03 mg/m ³	Easy to use. Screening layers filter out potential interferences. Dual threshold badge. Enhanced sensitivity. Results available immediately.	Limited accuracy ± 20%. Interferences from chlorine, bromine, and strong oxidizers. Require refrigeration at 4°C.

Appendix 3 - MERCURY INDUSTRIAL HYGIENE MONITORING METHODS (Continued)**METHODS REQUIRING ANALYSIS**

UNIT NAME	MODEL CATALOG	AVAILABLE FROM	PRINCIPAL OF OPERATION	RANGE mg/m³	ADVANTAGES	DISADVANTAGES
3M Mercury Vapor Monitor For Mercury Vapor Only	3600A 3600	3M Occupational Health & Safety Products 3M Center Building 220-3E-04 St. Paul, MN 55144-1000 1-800-243-4630 Fax 1-800-542-9373	Deposition of mercury on gold film.	0.005 - 0.20 mg/m ³ Hg	Analysis done by 3M Company. Monitor 3600A can be used in presence of chlorine. Designed to measure time weighted average.	Limited accuracy \pm 20%. Strong oxidizers such as halogens interfere with 3600. Mail away for analysis.
Mercury Vapor Badge For Mercury Vapor Only	WS-17417	Lab Safety Supply P.O. Box 1368 Janesville, WI 53547-1368 1-800-356-0783	Deposition of mercury on gold film.	0.002 - 0.2 mg/m ³ (8 hours).	Easy to use. Designed to measure time weighted average.	Limited accuracy \pm 20%. Mail away for analysis.
SKC Sorbent Badge Capsule (For Mercury Vapor) SKC Sorbent Tube with Mixed Cellulose ester filter and pump (For Mercury Particulate)	520-02A 226-17-1A	SKC, Inc. 863 Valley View Road Eighty-four, PA 15330-9614 412-941-9701 1-800-SKC-84PA Fax 412-941-1369	Absorption of mercury by solid hopcalite sorbent and analysis by cold atomic absorption.	Validation Range: 0.061 - 0.20 mg/m ³	Greater sample stability due to irreversible affinity of mercury with hopcalite not affected by chlorine, moisture. Analysis done by any qualified lab. Badge holder may be cleaned and reused. Analysed OSHA method ID-140.	Particulate compounds cannot be collected with the passive capsule. Its sampling rate is dependent on face velocity. Sorbent tube depend on a calibrated pump to take the sample. Mail away for analysis.
Mercury Vapor Monitor For Mercury Vapor Only		Advanced Chemical Sensors Co. 3201 N. Dixie Hwy Boca Raton, FL 33431 407-338-3116	Deposition of mercury on gold film.	0.001 - 2.0 mg/m ³ (8 hr)	Analysis is by OSHA method ID-140	At .05 mg/m ³ \pm 10% Mail away for analysis.

METHODS #	SAMPLING MEDIA	VOLUME min-max(L)	FLOW RATE L/min.	ANALYTICAL TECHNIQUE	RANGE ug/SAMPLE	ADVANTAGES	DISADVANTAGES
NIOSH 6009 issued on 5/15/89 for Mercury Vapor and Particulate	Hydrar in single section (200 mg) tube	Min: 2L Max: 100L	0.15 to 0.25 L/min.	Cold vapor atomic absorption	0.1 to 1.2 ug/sample	Not affected by high humidity. A prefilter can be used to exclude particulate mercury species from the sample. The prefilter may be analyzed for particulate Hg by similar methodology.	Inorganic and organic mercury compounds may cause positive interference. Oxidizing gases including chlorine do not interfere. A significant loss of mercury vapor due to the prefilter has been noted. This would give a false high for particulate and a false low for vapor.
<p><u>Available from:</u></p> <p>Peter M. Eller, Ph.D., C.I.H. Research Chemist NIOSH, R-2 Alice Hamilton Lab 4676 Columbia Parkway Cincinnati, OH 45226 513-841-4256</p>							

Appendix 3 - MERCURY INDUSTRIAL HYGIENE MONITORING METHODS (Continued)**METHODS REQUIRING ANALYSIS**

METHODS #	SAMPLING MEDIA	VOLUME min- max(L)	FLOW RATE L/min.	ANALYTICAL TECHNIQUE	RANGE ug/ SAMPLE	ADVANTAGES	DISADVANTAGES
OSHA Method ID-140 Revised Dec. 1989 For Mercury Vapor Only (P) For Total Vapor and particulate (A)	Hydrar or Hopcalite as the solid sorbent. May be done using a pump [active sample(A)] or a passive dosimeter device (P)	(P) 4.8 to 9.6L (A) 3-100L	(P) 0.020 L/min. (A) 0.20 L/min.	Cold vapor atomic absorption	0.1 to 2 ug/sample	Adequate sensitivity. Passive dosimeter requires no sampling pump. Dosimeter housing reusable. Chlorine in the air does not interfere.	Passive Dosimeter (P). Particulate compounds cannot be collected with this device. Sample rate dependent on face velocity; should not be used in areas where air velocity is > 229 m/min (750 ft/min). Active Sampler (A). Dependence on a calibrated pump to take sample. Cannot distinguish between mercury vapor and particulate; both are measured.

Available From:

Rick Cee, Acting Director
 OSHA SLC Analytical Laboratory
 1781 South 300 West
 P.O. Box 65200
 Salt Lake City, UT 84165-0200
 801-487-0267

Appendix 3 - MERCURY INDUSTRIAL HYGIENE MONITORING METHODS (Continued)**METHODS REQUIRING ANALYSIS**

METHODS #	SAMPLING MEDIA	VOLUME min-max(L)	FLOW RATE L/min.	ANALYTICAL TECHNIQUE	RANGE ug/ SAMPLE	ADVANTAGES	DISADVANTAGES
OSHA Method ID-145 Revised Dec. 1989 For Mercury Particulate Only	0.8 um mixed cellulose ester (MCE) filter	10 liters recommended for measuring compliance with the ceiling PEL. Full shift for evaluation of entire workday.	2.0 L/min. recommended	Cold vapor atomic absorption spectro- photometry	0.1 to 2 ug	Wipe or bulk samples can also be collected and analyzed using this method. Adequate sensitivity. Particulate organo- mercury compounds will also be collected, if present, using 0.8 um mixed cellulose ester (MCE) filter.	Elemental mercury vapor can not be collected on the 0.8 um MCE filters. Some volatile organic compounds (i.e. benzene, toluene, acetone, carbon tetra- chloride) may cause positive interferences (occurring as contaminants in the reagents used during sample preparation). These interferences can be rendered insignificant by using organic-free deionized water and at least reagent grade chemicals or by blank subtraction.

Available From:

Rick Cee, Acting Director
 OSHA SLC Analytical Laboratory
 1781 South 300 West
 P.O. Box 65200
 Salt Lake City, UT 84165-0200
 801-487-0267

Appendix 3 - MERCURY INDUSTRIAL HYGIENE MONITORING METHODS (Continued)

WIPE SAMPLING METHODS

Wipe Sampling Method Requiring Analysis: Put on a pair of clean impervious gloves. Wipe 100 sq cm of the surface considered contaminated with a smear tab or wipe filter moistened with distilled water. Without allowing the filter to contact any other surface, fold the filter with the exposed side in, then fold it over again. Place the filter in a plastic bag and zip shut or in a sample vial and cap, number it and send the sample for analysis. Paper or plastic cap liners should be used. Tin or other metal cap liner should not be used as they can amalgamate with free mercury and its compounds. The sample vials should be sealed with vinyl shrink bands or electrician's tape. Analyses by OSHA Method ID-145.

Smear Tabs, Part No. 225-2401
SKC Inc.
863 Valley View Road
Eighty-four, PA 15330-9614
412-941-9701
1-800-SKC-84PA
Fax 412-941 -1369

OR

A Wipe Filter, Part No. 1451-D993
Whatman Lab Sales, Inc.
P.O. Box 1359
Hillsboro, OR 97123
503-648-0762

Direct Reading Surface Test Kits: Available from SKC, Inc. (See address and phone above.) Mercury check swabs are impregnated cartridges which can be used for a rapid screening test to detect mercury on surfaces. Each swab has a cotton tip treated with a special mercury reactive dye, and a liquid contained in a crushable vial. When the vial is crushed, the treated swab tip becomes moist. Rubbing the swab over a surface coated with mercury compounds produces a distinctive color on the swab or the surface. A mercury-treated card or stick is provided for verifying results.

APPENDIX 4

COMMERCIAL MERCURY CLEAN-UP/CONTROL PRODUCTS

**Solucorp Industries
520 Victor Street
Saddle Brook, NJ 07663
201-368-7902**

Mercontainer

Merconsponge

Merconvap Industrial

- Produce mercury sulphite and absorb mercury molecules from the air

Merconspray

Merconwipes

Merconvap

- Produce mercuric iodide and absorbs mercury molecules from the air

Mercongel

- Antibacterial and antiviral; stops the methylation of mercury in water

Merconwash

- Cleans mercury contaminated instruments, bottles or surfaces

Lab Safety Supply

P.O. Box 1368

Janesville, WI 53547-1368

1-800-356-0783

Signs and Labels

- Graphic warning self-adhesive labels

Mercury Indicator Powder

- Color change from yellow to brown overnight

Mercury Vacuum Cleaner by Hako Minutemen

- Compact Mini-Merc Mercury Vacuum by Nilfisk

Mercury Vapor Absorbent

- Reduces concentrations of mercury vapor remaining after clean-up of spills

Mercury Spill Control Station

Mercury Absorb Powder

Mercury Sponges

- Decontaminate an area after a mercury spill

Mercury Vapor Detector

- Passive dosimeters detect the presence of mercury vapor

Mercury Spill Kits
Mercury Check Swabs by Lead Check
- Detects mercury ions on surfaces and in liquids
Mercury Absorb Jar
Mercury Hand Vacuum

J.T. Baker, Inc.
222 Red School Lane
Phillipsburg, NJ 08865
1-800-582-2537

Cinnasorb to pick-up spills
Resisorb for adsorption and disposal
Mercury Indicator to detect mercury

APPENDIX 5

NIOSH-APPROVED CARTRIDGE RESPIRATORS FOR PROTECTION AGAINST MERCURY VAPOR

**3M Occupational Health and Safety Products
3M Center Building, 220-3E-04
St. Paul, MN 55144-1000
1-800-243-4630**

- **6009 mercury vapor or chlorine gas cartridge. For use up to 10 X PEL when used with 6000 Series half mask or 50 X PEL with 7800 Series full-facepiece respirator.**
 - **End-of-service-life indicator for mercury vapor changes color from orange to brown when the cartridge is to be discarded. All cartridges are face-mounted, but color change is visible to the wearers.**
 - **NIOSH Approval # TC-23C-1424 to TC-23C-1440 and TC-23C-1557 to TC-23C-1561**
 - ***The 3M 9908 single use disposable mercury respirator is NOT approved by NIOSH for protection against mercury vapor.***
-

**GPT, Inc.
5300 Region Court
Lakeland, FL 33801
1-800-645-7530**

- **C27A mercury vapor and chlorine gas cartridge. For use with Model # GR-9527-BM-A (F950-BM facepiece and C27 cartridges) up to 10 X PEL.**
 - **Approval limited to belt-mounted respirator; face-mounted acceptable under certain conditions (mirror or buddy system). Cartridge changes color from orange to gray.**
 - **NIOSH Approval # TC-23C-916.**
-

**Cabot Safety Corporation
90 Mechanic Street
Southbridge, MA 01550
1-800-444-4774**

- **R59A mercury cartridge to be used on half-mask or full-facepiece for use up to 10 X PEL.**
 - **Approval limited to belt-mounted which is not available. Use in face-mounted position is acceptable under certain conditions (mirror or buddy system)**
 - **NIOSH Approval # TC-23C-1031, TC-23C-1032, TC-23C-1344, TC-23C-1384.**
 - **End-of-service-life indicator changes from orange to dark gray when the cartridge is to be discarded.**
-

**Survivair
3001 South Susan Street
Santa Ana, CA 92704
1-800-821-7236**

- **100600 metallic mercury vapor and chlorine gas cartridge for use with either belt or face-mounted respirators for up to 10 X PEL. End-of-service-life indicator changes color from yellow to gray when the cartridge is to be discarded.**
 - **NIOSH Approval # TC-23C-1483.**
-

**Willson Safety Products
P.O. Box 622
Reading, PA 19603
1-800-977-9177**

- **T07 mercury vapor/chlorine gas cartridge. For use with 6100 half mask and 6400/6500 (full facepiece) up to 10 X PEL.**
- **Approval limited to belt-mounted which is not available. Use in face-mounted position is acceptable under certain conditions (mirror or buddy system)**

- **End-of-service-life-indicator changes color from orange-pink to dark gray when cartridge is to be discarded.**
 - **NIOSH Approval # TC-23C-1356 (half-mask) and # TC-23C-1357 (full-facepiece).**
-

**MSA
P.O. Box 426
Pittsburgh, PA 15230
1-800-672-2222**

- **MSA twin-cartridge respirator with Mersorb (NIOSH Approval # TC-23C-629) and Mersorb H (NIOSH Approval # TC-23C-1046) cartridge. Mersorb can only be belt-mounted. Affords protection up to 10 X PEL.**
 - **Advantage 1000 Series with Mersorb H (TC-23C-1422).**
 - **Powered Air Purifying Respirator (PAPR) with Mersorb H.**
 - **NIOSH Approval # TC-23C-1464 half-mask with protection up to 25 X PEL.**
 - **NIOSH Approval # TC-23C-1465 full-facepiece with protection up to 50 X PEL.**
 - **Mersorb H Cartridge also offer protection against dusts, fumes, asbestos containing dusts and mists, and radionuclides.**
 - **End-of-service-life-indicator changes color from orange to brown when cartridge is to be discarded.**
-

APPENDIX 6

FACILITIES WHICH ACCEPT MERCURY-CONTAINING WASTE

Advanced Environmental Recycling Corp.
2591 Mitchell Avenue
Allentown, PA 18103
610-797-7608
1-800-554-2372

Advanced Environmental Technical Services
3100 Hedley Street
Philadelphia, PA 19137
215-289-3700
and
One Eden Lane
Flanders, NJ 07836
201-347-7111
1-800-426-2382

Bethlehem Apparatus Company, Inc.
890 Front Street
P.O. Box Y
Hellertown, PA 18055
610-838-7034

Mercury Refining Company
1218 Central Avenue
Albany, NY 12205
518-459-0820
1-800-833-3505

NSSI/ Recovery Services, Inc.
P.O. Box 34042
Houston, TX 77234
713-641-0391

Stablex Canada Incorporated
760 Industrial Blvd.
Blainville, Quebec J7C-3V4
Canada
1-800-361-9460 Canda
1-800-782-2539 U.S.
514-430-9230